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Response to Office Action Dated 10/04/2005

AMENDMENTS TO THE CLAIMS

In accordance with the PTO's amendment format, a detailed listing of all claims has been provided. A status identifier is provided for each claim in parentheses following each claim number. Changes to the claims are shown by strikethrough or double bracketing (for deleted text) or underlining (for added text).

In the Claims:

Claims 1-40 were previously pending.

Claims 1-10 are allowed.

Please amend claims 11-36, and 39 as shown below.

Please cancel claims 37, 38, and 40 without prejudice.

No new claims are added.

Claims 1-36, and 39 are pending.

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Listing of the Claims

1. (Allowed) A method comprising:
extracting an intensity feature, a timbre feature, and a rhythm feature from a music clip;
classifying the music clip into a mood group based on the intensity feature;
and
classifying the music clip into an exact music mood from the mood group based on the timbre feature and the rhythm feature.
2. (Allowed) method as recited in claim 1, wherein the extracting comprises:
converting the music clip into a uniform music clip having a uniform format;
dividing the uniform music clip into a plurality of frames; and
dividing each frame into a plurality of octave-based frequency sub-bands.
3. (Allowed) A method as recited in claim 2, wherein the extracting an intensity feature comprises:
calculating a root mean-square (RMS) signal amplitude for each sub-band of each frame;
summing the RMS signal amplitudes across the sub-bands of each frame to determine a frame intensity for each frame; and

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averaging the frame intensities to determine the intensity feature for the music clip.

4. (Allowed) A method as recited in claim 2, wherein the extracting a timbre feature comprises:

calculating spectral shape features for each frame;

calculating spectral contrast features for each frame; and

representing the timbre feature with one or more of the spectral shape features and/or the spectral contrast features.

5. (Allowed) A method as recited in claim 2, wherein the extracting a rhythm feature comprises:

extracting an amplitude envelope from the lowest sub-band and the highest sub-band of each frame across the uniform music clip;

estimating a difference curve of the amplitude envelope; and

detecting peaks above a threshold within the difference curve, the peaks being instrumental onsets.

6. (Allowed) A method as recited in claim 5, wherein the extracting a rhythm feature further comprises:

extracting an average rhythm strength of the instrumental onsets;

extracting a rhythm regularity value based on the average of the maximum three peaks in the difference curve; and

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extracting a rhythm tempo based on a common divisor of peaks in the difference curve.

7. (Allowed) A method as recited in claim 1, wherein the classifying the music clip into a mood group comprises:

determining the probability of a first mood group based on the intensity feature;

determining the probability of a second mood group based on the intensity feature;

selecting the first mood group if the probability of the first mood group is greater than or equal to the probability of the second mood group; and

otherwise selecting the second mood group.

8. (Allowed) A method as recited in claim 1, wherein the classifying the music clip into a mood group comprises classifying the music clip into a mood group selected from the group comprising:

a contentment and depression mood group; and

an exuberance and anxious mood group.

9. (Allowed) A method as recited in claim 1, wherein the mood group includes a first mood and a second mood, the classifying the music clip into an exact music mood comprising:

determining the probability of the first mood based on the timbre feature and the rhythm feature;

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determining the probability of the second mood based on the timbre feature and the rhythm feature;

selecting the first mood as the exact mood if the probability of the first mood is greater than or equal to the probability of the second mood; and
otherwise selecting the second mood as the exact mood.

10. (Allowed) A method as recited in claim 9, wherein the mood group is selected from the group comprising:

a first mood group that includes a contentment mood and a depression mood; and

a second mood group that includes an exuberance mood and an anxious mood.

11. (Currently Amended) A method, comprising: ~~processor-readable medium comprising processor-executable instructions configured for:~~

extracting features from a music clip;

selecting a first mood group or a second mood group based on a first feature; and

determining an exact mood from within the selected mood group based on a second feature and a third feature.

12. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 11, wherein the extracting comprises:

down-sampling the music clip into a uniform format;

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dividing the music clip into a plurality of frames; and
dividing each frame into a plurality of frequency sub-bands.

13. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 12, wherein the down-sampling comprises converting the music clip into a 16 KHz, 16 bit, mono-channel uniform sample.

14. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 12, wherein the dividing the music clip into a plurality of frames comprises dividing the music clip into non-overlapping, 32 microsecond-long frames.

15. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 12, wherein the dividing each frame into a plurality of frequency sub-bands comprises dividing each frame into seven frequency sub-bands, each sub-band being an octave sub-band.

16. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 12, wherein the extracting comprises extracting an intensity feature.

17. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 16, wherein the extracting an intensity feature comprises extracting an intensity feature for each frame, and ~~the processor-readable medium~~

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~~comprising further processor-executable instructions configured for calculating a~~
root mean-square (RMS) signal amplitude for each sub-band of each frame.

18. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 17, further comprising ~~further processor-executable instructions configured for~~ summing the RMS signal amplitudes across the sub-bands of each frame to determine a frame intensity feature for each frame.

19. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 18, further comprising ~~further processor-executable instructions configured for~~ averaging the frame intensity features across all frames to determine a music clip intensity feature.

20. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 12, wherein the extracting comprises extracting a timbre feature.

21. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 20, wherein the extracting a timbre feature comprises extracting a timbre feature for each frame, and wherein the extracting a timbre feature for each frame comprises:

determining spectral shape features;

determining spectral contrast features; and

representing the timbre feature with the spectral shape features and the spectral contrast features.

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22. (Currently Amended) A method ~~processor-readable-medium~~ as recited in claim 21, wherein the determining spectral shape features comprises determining one or more shape features from the group comprising:

- a frequency centroid of a frame;
- a frequency bandwidth of a frame;
- a frequency roll off of a frame; and
- a spectral flux of a frame.

23. (Currently Amended) A method ~~processor-readable-medium~~ as recited in claim 21, wherein the determining spectral contrast features comprises determining one or more contrast features from the group comprising:

- a spectral peak in a sub-band of a frame;
- a spectral valley in a sub-band of a frame; and
- a spectral average of all spectral components in a sub-band of a frame.

24. (Currently Amended) A method ~~processor-readable-medium~~ as recited as recited in claim 12, wherein the extracting comprises extracting a rhythm feature.

25. (Currently Amended) A method ~~processor-readable-medium~~ as recited in claim 24, wherein the extracting a rhythm feature comprises:

- extracting an amplitude envelope from a lowest sub-band and a highest sub-band;

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estimating a difference curve of the amplitude envelope; and
detecting peaks above a threshold within the difference curve, the peaks
being bass instrumental onsets.

26. (Currently Amended) A method ~~processor-readable medium~~ as
recited as recited in claim 25, wherein the extracting a rhythm feature further
comprises:

extracting an average rhythm strength of the instrumental onsets;
extracting a rhythm regularity value based on an average of the maximum
three peaks in the difference curve; and
extracting a rhythm tempo based on a common divisor of peaks in the
difference curve.

27. (Currently Amended) A method ~~processor-readable medium~~ as
recited in claim 11, wherein the selecting comprises:

determining the probability of the first mood group given the first feature;
determining the probability of a second mood group given the first feature;
selecting the first mood group if the probability of the first mood group is
greater than or equal to the probability of the second mood group; and
otherwise selecting the second mood group.

28. (Currently Amended) A method ~~processor-readable medium~~ as
recited in claim 27, wherein the first feature is an intensity feature.

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29. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 27, wherein the first mood group comprises a contentment mood and a depression mood, and the second mood group comprises an exuberance mood and an anxious mood.

30. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 11, wherein the selected mood group comprises a first mood and a second mood, and the determining an exact mood from within the selected mood group comprises:

determining the probability of the first mood given the second and third features;

determining the probability of a second mood given the second and third features;

selecting the first mood as the exact mood if the probability of the first mood is greater than or equal to the probability of the second mood; and

otherwise selecting the second mood as the exact mood.

31. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 30, wherein the determining the probability of the first mood given the second and third features comprises:

determining a weighted first probability, the weighted first probability being a first weight multiplied by the probability of the first mood based on the second feature;

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determining a weighted second probability, the weighted second probability being a second weight multiplied by the probability of the first mood based on the third feature, wherein the sum of the first weight and the second weight is equal to one; and

summing the weighted first probability and the weighted second probability.

32. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 30, wherein the determining the probability of the second mood given the second and third features comprises:

determining a weighted first probability, the weighted first probability being a first weight multiplied by the probability of the second mood based on the second feature;

determining a weighted second probability, the weighted second probability being a second weight multiplied by the probability of the second mood based on the third feature, wherein the sum of the first weight and the second weight is equal to one; and

summing the weighted first probability and the weighted second probability.

33. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 30, wherein the second feature is a timbre feature and the third feature is a rhythm feature.

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34. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 11, wherein the extracting comprises:

extracting an intensity feature;
extracting a timbre feature; and
extracting a rhythm feature.

35. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 11, further comprising ~~further processor-executable instructions configured for:~~

constructing a Gaussian Mixture Model (GMM) to model each feature; and
estimating parameters of a Gaussian component and mixture weights within the GMM using an Expectation Maximization (EM) algorithm.

36. (Currently Amended) A method ~~processor-readable medium~~ as recited in claim 35, further comprising ~~further processor-executable instructions configured for~~ initializing the GMM using a K-means algorithm.

37-38. (Canceled)

39. (Currently Amended) A ~~computer as recited in claim 38,~~ further comprising:

a music clip;

a mood detection algorithm configured to classify the music clip as a music mood according to music features extracted from the music clip;

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a music feature extraction tool configured to extract the music features; and
a hierarchical music mood detection process configured to determine a mood group based on a first music feature and an exact music mood from within the mood group based on a second and third music feature.

40. (Canceled)